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REMOTE: A Means of Remotely Controlling and Storing Data from a HAL Quadrupole Gas Analyzer Using an IBM-PC Compatible Computer (Documentation for Version 2.6)

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Prepared by

B. P. KASPER
Space and Environment Technology Center
Technology Operations

Prepared for

SPACE AND MISSILE SYSTEMS CENTER
AIR FORCE MATERIEL COMMAND
2430 E. El Segundo Boulevard
Los Angeles Air Force Base, CA 90245

Engineering and Technology Group

THE AEROSPACE CORPORATION
El Segundo, California

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Mark W. Borden, CAPT, USAF
Manager, Advanced Technology
Development
DMSP Program Office

Martin K. Williams, CAPT, USAF
Manager, Space Systems Integration
DCS for Program Management

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Kasper, Brian P.

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This report is a users' manual for REMOTE–a program used to control a Hiden Analytical Ltd. (HAL) quadrupole gas analyzer. This report also explains fully the capabilities of REMOTE for a prospective user. Designed for use on an IBM-PC compatible computer, REMOTE communicates with the analyzer over an RS232 communications line. The HAL analyzer can be instructed to take a predetermined set of mass spectra and store the data on disk for later analysis in a spreadsheet program. REMOTE mimics the control structure of the analyzer's own software very closely. Because of this, anyone already familiar with the HAL analyzers can readily learn to use REMOTE.

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CONTENTS

I. INTRODUCTION

REMOTE is a utility that allows remote control of a Hiden Analytical Ltd. quadrupole gas analyzer via an IBM-PC compatible using an RS232 connection. With REMOTE, command files can be easily and quickly constructed by anyone who knows how to operate the analyzer (hereafter called the Hiden). Once constructed, a command file can be used to take a predetermined set of mass spectra with a single instruction from the PC. Mass spectra can be printed out as often as desired. In addition to controlling the Hiden, REMOTE permits the user to store each mass spectrum on disk in a format convenient for subsequent analysis in a spreadsheet program such as LOTUS 1-2-3.

REMOTE was designed specifically as a substitute for MASYST, the control software provided by Hiden Analytical Ltd. This software, while useful, contains a few critical deficiencies, such as

1. The need to create a new environment file and a new data file for each data scan (mass spectrum).
2. The lack of a convenient data format that will facilitate data transfer to a spreadsheet program.
3. Inaccuracies in setting range values for the electron multiplier.
4. The inability to turn on the electron multiplier when the pressure exceeds 10^{-6} torr, except by returning to local mode.

The inaccuracies in MASYST will undoubtedly be corrected, but the remaining deficiencies still greatly reduce its usefulness. In order to work around these deficiencies, REMOTE was created. REMOTE, however, uses a different user interface for, and approach to, controlling the Hiden.

II. REMOTE BASICS

The basic technique used in REMOTE is duplication of the soft-key command structure used by the Hiden's internal control software. By re-creating the soft keys on the PC screen and directly utilizing the Hiden's internal menu tree, REMOTE allows immediate use by anyone already familiar with the Hiden commands. Therefore, instead of learning an entirely new program, one simply duplicates the commands that would be entered if one were using the green soft keys on the Hiden.

The numeric keys on the main PC keyboard or the numeric keypad in the Num Lock mode can be used to enter values just as the black keys on the Hiden are used. The values entered are displayed on the PC screen and can be edited using the Backspace key. Also, by pressing ALT-C,[1] an entire sequence of values may be cleared. The space bar (not the * key!) is used to separate multiple values. A value string is sent only when a function key that can be prefaced with values is pressed. Hence, values can be entered, the Return key (which never needs values) pressed, and the values will remain active. Only when a key that can be prefaced with a value string (SPAN, START, or MASS, for example) is pressed will the values be sent.

Not all commands are available, unfortunately. The calibration menu (CAL) and all of its submenus are not accessible remotely, nor are the various TUNE submenus and the BAR LBRARY submenus. The Hiden's communications software does not permit remote access to these menus. Also, there is one significant difference between REMOTE commands and commands as they would be entered on the Hiden using the green soft keys. On the Hiden, the soft-key sequence when taking a scan is START-STOP-ABORT-START. What this means is that when the START key is pressed, it changes to STOP. When this STOP key is pressed, it changes to ABORT, and after the scan is completed, to START again. In REMOTE, however, the sequence is START-ABORT-START. The STOP key on the Hiden halts execution after the current scan, allowing data logging. This soft key is not available when sending remote commands. ABORT aborts the entire scan sequence without the possibility of logging data. The unavailability of the STOP key in remote operation leads to a difference in the way a single scan can be taken. When using the green keys on the Hiden itself, a single scan can be taken by pressing START and then immediately pressing STOP; a scan will be taken, at which point the soft key will reset to START. In REMOTE, a single scan can only be taken by entering a value of 1 before the START key is pressed. Hence, the command is 1 START.

Generally, the ASCII strings that REMOTE uses to control the Hiden are the commands that appear on the Hiden's own screen in the soft-key diagram. The function keys (F1–F10) on the PC keyboard are mapped onto the green keys on the Hiden control panel. As such, the keyboard format with the 10 function keys in a 5 x 2 rectangle at the left of the keyboard (for instance, the Keytronic KB5184WP Professional Series) is much preferred to the enhanced

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[1]Pressing ALT-C represents holding the Alt key down and pressing the C key. Similarly, ALT-D would indicate holding the Alt key down and pressing the D key. In this documentation, <ESC> specifies the Escape key, CRTL specifies the Control key, and <CR> specifies the Carriage Return key.

101-key format. The 5 x 2 function-key layout is the closest analog to the Hiden's keys. REMOTE maps the IBM function-key layout onto the Hiden key layout as follows:

IBM			HIDEN Green Keys	
F1	F2		Key 1	Key 2
F3	F4		Key 3	Key 4
F5	F6	→	Key 5	Key 6
F7	F8		Key 7	Key 8
F9	F10			

F9 is the CMD FILE key, and F10 is the DOS EXIT key. Their uses are explained below.

A different command structure is available for users with a keyboard that does not have the function-key layout in a 5 x 2 rectangle. The format is

IBM			HIDEN Green Keys	
Home	PgUp		Key 1	Key 2
			Key 3	Key 4
End	PgDn	→	Key 5	Key 6
Ins	Del		Key 7	Key 8
UpAr	DnAr			

UpAr is the CMD FILE key, and DnAr is the DOS EXIT key, where UpAr is the Up Arrow key (8 on the numeric keypad) and DnAr is the Down Arrow key (2 on the numeric keypad). The 5 x 2 function-key layout is simpler and closer to the Hiden's own key structure than is the layout using the numeric keypad, which is why the function-key format is recommended.

No matter which key layout is used, the command sequences are the same. The exact same key presses are used to control the Hiden via REMOTE as are used to control the Hiden via its own keypad. The PC screen display changes to reflect the active menu in the same way that the soft keys change on the screen of the Hiden. REMOTE control of the Hiden is, therefore, very similar to the standard means of control.

III. REMOTE FEATURES

A. TTY MODE

REMOTE has features that greatly enhance its flexibility and usefulness. One of these is TTY mode. TTY mode[2] is a means of taking direct control of the Hiden independently of the soft-key menu structure. When in TTY mode, all characters typed are sent directly to the Hiden, and all characters received are displayed directly on the PC screen. For users familiar with the actual ASCII commands used to control the Hiden, this is a means of bypassing REMOTE's high-level structure and getting at the *bones* of the Hiden itself. Except as noted in the Hiden manuals, all commands must be entered in UPPER CASE letters. Replies from the Hiden have the format "OK+ answer" or "ERROR answer," where "answer" represents information that depends on the command given. For many commands, if they are correctly entered, the reply will be simply "OK"; all ERROR replies, however, will include a number that indicates the type of error. See the Hiden manual for further details. TTY mode is entered by pressing ALT-T. To exit TTY mode, press <ESC> at any time.

B. DATA LOGGING

Another REMOTE feature is data logging. Data logging is a means of recording data from BAR, PROF, and MID scans onto the PC's hard disk. The data files can then be read at a later time into a spreadsheet program for analysis. Data are stored in a text format (which can also be viewed using the DOS "TYPE" command). An example of a data file is as follows:

---

[2]This feature is known as TTY mode because the format is the same as that of a terminal teletype, in which all characters typed are sent over the communications line, and all characters received over the communications line are displayed on the screen.

{---------- BEGINNING OF FILE ----------}

"01/14/1991"	"01/14/1991"
"10:53:55"	"10:54:11"
"MODE: BAR"	"MODE: BAR"
"COL: FARADAY"	"COL: FARADAY"
"RNG: X10-7"	"RNG: X10-7"
"STRT: 40"	"STRT: 40"
"STOP: 60"	"STOP: 60"
803E-10	821E-10
75E-10	76E-10
223E-10	223E-10
136E-10	140E-10
366E-10	335E-10
.	.
.	.
more data	more data
.	.
.	.

{---------- END OF FILE ----------}

Lines enclosed by braces {} are not actually in the file.

If multiple scans are taken at one time (by keying in "2" before issuing the START command), the data will be stored side by side, as shown above; if only one scan is taken, it will be stored in single-column format. If an existing file has data appended to it, the data will not be added side by side, but at the end of the file; for example, if a single scan is taken, followed by another single scan, data will be stored in one column.

The date and time at which the scan was taken are the first two fields in a data file. Next are fields specifying the mode in which the data were taken, the detector used (Faraday or multiplier), the chosen range value, and the beginning and ending masses for the scan. The actual scan data follow in scientific notation. In order to use the data in, for example, a LOTUS 1-2-3 spreadsheet, one must import the file as numbers. The entire command sequence for LOTUS 1-2-3 would be /File Import Numbers followed by the file name. REMOTE data files by default have the extension .DAT.

Data logging is turned on or off by pressing ALT-L. To change the data file name, press ALT-D. There are two options for the data file name: Enter File Name and Create Name From Time. The active option will be the one highlighted in the Data File Name window which opens when ALT-D is pressed. To switch options, use the up and down arrow keys on the numeric keypad. Enter File Name allows you do do exactly that: specify explicitly the DOS file name of the file to which you wish the data to be written. Create Name From Time, on the other hand, allows you to "date stamp" each data file. When this option is chosen, the name

of the file will be created using the date and time at which the scan was started. The actual name will have the format

MMDDhhmm.DAT

where MM is the month, DD is the day, hh is the hour, and mm is the minute. This allows the user to correlate data by scan time and also differentiates data scans (mass spectra) for easy cataloging. If multiple scans are taken and stored in one file, i.e., the scan is initiated with the command 2 START instead of 1 START, the name of the file will be created from the date and time of the first scan in the file. The default data name is HIDEN.DAT. If a data file already exists on the disk, any additional data saved to that file will be appended to the end of the file.

When REMOTE is activated, data logging is on by default. This means that, unless the user deactivates logging, all scans will be saved to the disk. If a scan is aborted, the data will not be logged. This is true even for multiple scans. For example, if the user is taking 5 scans and presses the ABORT key during scan 4, the data from the first 3 scans will be lost in addition to the data for scans 4 and 5.

C. COMMAND LOGGING

The last, and most powerful, feature of REMOTE is command logging. When command logging is active, all commands sent to the Hiden and replies received from the Hiden are stored in a file known as a command file. The commands are stored in text format, with one command or reply per line, in addition to other information added by REMOTE to assist with error detection.

Command logging is accessed by means of the CMD FILE key (F9 in the standard key format). When the CMD FILE key is pressed, the COMMAND FILE window opens on the PC screen. The menu in this window contains all command log features. These features are

(L)og Commands

(C)hange Command Log File

(E)xecute a Command File

The features are accessed by typing the indicated letter (L, C, or E). Pressing <ESC> exits the command file menu, closes the window, and returns the user to the main REMOTE mode.

1. Turning Logging On and Off

The (L)og Commands feature turns command logging on or off. If logging is on, all commands are stored in the file listed at the right side of the (C)hange Command Log File line. If logging is off, no commands are stored.

If command logging is turned on, and a file with the specified name already exists in the active directory, the user will be asked whether to (O)verwrite the file or (A)ppend the file. If the user specifies (O)verwrite, the old file will be **completely overwritten** with the new commands. BEWARE! There is no way to recover commands that have been overwritten. If (A)ppend is chosen, the commands logged to the file will be added at the end of the previous information in the file. The user may press <ESC> instead of A or O to abort without activating command logging.

2. Changing Command Log File Name

To change the name of the file to which commands are logged, press C for (C)hange Command Log File. The COMMAND LOG FILE NAME window opens, and the user is prompted for the new name of the file. The file name may be up to 8 characters long. The name may be edited using the Home, End, Backspace, Right Arrow, Left Arrow, and Delete keys. Home moves the cursor to the beginning of the name. End moves the cursor to the end of the name. The Backspace key moves the cursor one character back, erasing the character to the left of the cursor. The Arrow keys move the cursor through the name without erasing. The Delete key erases the character under the cursor without moving the cursor. Also, the Insert key toggles between Insert and Overwrite modes. When Insert mode is on, the cursor appears as a block. When Overwriting, the cursor appears as an underline. (Note: These editing features are also available whenever the user is prompted to enter a string of text.)

When the COMMAND LOG FILE NAME window initially opens, the old file name appears in the file-name field (the black-on-white area where the name is entered). If the user begins typing characters (A–Z, 1–9, etc.) before pressing any other key (such as Home, End, etc.) the previous name is completely erased and replaced with the new characters being typed. If Home, End, etc., are pressed, the previous name is not erased and may be edited. If, at any point before pressing <CR>, the user wishes to restore the old name, he or she may do so by moving the cursor to the beginning of the name and pressing CTRL-R. In addition, if the user, before pressing <CR>, wishes to abort without changing the command log file name, he or she may do so by pressing <ESC>. Once <CR> is pressed, however, the name appearing in the file-name field replaces the old name. If a file with the new name already exists in the active directory, "FILE EXISTS" appears directly beneath the file name in the COMMAND FILE window. If no file with that name currently exists, the message "NEW FILE" will appear.

Logging does not have to be turned off for the file name to be changed. If the command log file name is changed while logging is active, the old log file is closed, and output is switched to the new file.

3. Executing a Command File

This is the feature that makes command logging so powerful. Once commands have been stored in a command file, the user may repeat the entire sequence of commands by (E)xecuting it. A command file can, and usually will, contain instructions for taking several spectra in

sequence. In this way, REMOTE differs from mASYST, which requires a different environment file for each scan. A REMOTE command file might first command the Hiden to take a spectrum in the BAR mode with the Faraday cup, then to take a spectrum over a different mass range and at a different sensitivity range with the electron multiplier, then to take a spectrum in the MID mode, and so forth. Each spectrum can be stored in a different data file or can be appended to a previous data file. The command file can, and usually will, contain instructions for the Hiden to print each mass spectrum immediately after completion of its scan. If the clock has been set since the Hiden was last turned on, the print will contain the date and time of the scan, which will be approximately the same as the date and time given in its data file. If the "date stamp" option described above is used, the title of the data file will also contain the date and time at which the scan was taken. With mASYST, the Hiden cannot be instructed to print spectra, the user must type in a new data file name before each scan, and the data file does not contain the date or time of the scan or any other information to identify the data. With REMOTE, the command files are executed merely by entering the command file name into the PC. Without further user intervention, all commands in the file will be executed, which will typically mean that many spectra will be taken and printed, and numerical values of the data will automatically be stored in annotated files that can easily be transported to a spreadsheet program.

The following is an *extremely* brief example of a command file.

{---------- BEGINNING OF FILE ----------}

```
HIDEN REMOTE COMMAND FILE
  *** Command logging activated in menu SELECT on 01/16/1991 at 09:02:11
  *** Filament Status: OFF
  *** Multiplier Status: OFF
STATUS
     REPLY: OK
F1
  *** Filament Status: ON
     REPLY: OK
RETURN
     REPLY: OK
PROF
     REPLY: OK
X10-9
     REPLY: OK
105 MASS
     REPLY: OK
1 START
     REPLY: Scan completed and logged
RETURN
     REPLY: OK
  *** Command logging deactivated in menu SELECT on 01/16/1991 at 09:03:23
  *** Filament Status: ON
  *** Multiplier Status: OFF
```

{---------- END OF FILE ----------}

The lines enclosed in braces {} are not actually part of the file.

The preceding command file is used to turn on Filament 1, set the range and center mass, and take a scan in PROF mode. The only lines of the file that are absolutely necessary for successful execution are

{---------- BEGINNING OF FILE ----------}

```
HIDEN REMOTE COMMAND FILE
STATUS
F1
RETURN
PROF
X10-9
105 MASS
1 START
RETURN
```

{---------- END OF FILE ----------}

The first (longer) version of the command file shown above was created by activating command logging from within REMOTE and then entering the commands as if using the Hiden keypad. All of the lines in the file starting with "***" are comments inserted by REMOTE to assist with error checking; they are not necessary for execution of the file. The "REPLY:" lines are also not necessary; they simply reproduce the Hiden's response to a specific command. The second version of the file is a copy of the first file with all error-checking comments and replies removed.

It is possible to create or edit a command file using the nondocument (nonformatted) mode of any word processor. If this is done, the ***only*** requirements are that the file must start with the line "HIDEN REMOTE COMMAND FILE," each command must be on a new line, and each command must start at the left edge of the line. All text that starts in the first column is considered a command, and any text that is indented—that is, prefaced either with at least one space or tab—is considered a comment. Command files have the extension .CMD.

Whenever data logging is turned on or off (whenever ALT-L is pressed) while logging commands, the line "LOGGING: ON" or the line "LOGGING: OFF" is added to the file. This is the only command that appears at the left edge of the line that is not an actual command for the Hiden; this command is an internal REMOTE command. The LOGGING: ON and LOGGING: OFF commands make it possible for the user to control whether data logging is on or off at every point in a command file.

Often the user will want to specify at the beginning of a command file that data logging be turned on before the first scan is taken. The command "LOGGING ON" ensures this. If data logging is off at the start of command logging, ALT-L must be pressed once, and the command "LOGGING: ON" will be added to the command file. If data logging is on at the start of command logging, ALT-L must be pressed twice, and the command "LOGGING: OFF" followed by the command "LOGGING: ON" will be added to the command file. When the command file is later executed, REMOTE will come across the lines "LOGGING: OFF" and "LOGGING: ON" in succession. Data logging will be forced off and then back on by these lines.

There is no limit to the number of times logging can be turned on or off in a command file. However, to avoid confusion, when two or more LOGGING commands are in a file in immediate succession (as they would be in the above example when ALT-L was pressed twice), all of the lines except for the last one may be removed by the user during command file editing.

As previously mentioned, the "LOGGING: [ON/OFF]" commands are the only lines that will be unindented in a command file but are not actual commands for the Hiden. Commands sent to the Hiden during the execution of a command file are identical to those listed in the command file, with just two exceptions. The two exceptions are the commands to enter the RANGE and DWELL submenus.

When a user sets a scan sensitivity range, he or she presses the RANGE soft key to enter a RANGE submenu. Then, he or she presses the soft key indicating the desired range. Unfortunately, many problems surface if the Hiden is in a RANGE submenu when REMOTE is

activated. For example, the commands REMOTE uses to determine the Hiden's menu location tend to make the Hiden freeze if the commands are issued while the Hiden is in a RANGE submenu. Because of this, REMOTE cannot permit a user to exit to DOS or send any commands while in a RANGE submenu. This is done by delaying transmittal of the command to enter the RANGE submenu until ***immediately before*** the actual RANGE command (i.e., X10–8) is sent to the Hiden. To implement this delay, command files have a special method of setting ranges. The command "RANGE" will never be found in a command file. Instead, only the range setting command (i.e., X10–8) will be present. When REMOTE detects a range setting command in a command file it is executing, the RANGE command is automatically sent before the range setting command. For example, when a user creates a command file with a word processor and wishes to set the range to X10–8 in PROF mode, the file must read

{previous commands}
PROF
X10–11
{more commands}

instead of

{previous commands}
PROF
RANGE
X10–11
{more commands}

as one might assume.

The same situation occurs when setting DWELL times in MID mode. The DWELL command will not appear in the command file and should not be included when a user creates a command file with a word processor. As an example, for a setting of 3 seconds, the file should read

{previous commands}
MID
3SEC
{more commands}

instead of

{previous commands}
MID
DWELL
3SEC
{more commands}

As stated previously, the "***" lines inserted by REMOTE are not necessary for the command file to be executed, but they are extremely helpful. These lines contain information about the

status of the Hiden at the time the file was created from within REMOTE. With this information, REMOTE can make sure that the Hiden is in the proper state for successful execution of the command file. The status information is of three types: menu location, filament status, and electron multiplier status. REMOTE checks a command file before beginning execution. All filament, multiplier, and menu status lines at the start of the command file are checked to ensure that they make sense and contain consistent information.

The menu location lines include both a menu name and a date/time stamp. The menu name allows REMOTE to make sure that the Hiden is in the proper menu before executing a command file. If the Hiden is not in the proper menu, REMOTE prints an error message directing the user to switch the Hiden to the proper menu. REMOTE also checks before executing a command file that each set of appended commands begins in its proper menu. The first command of a set of appended commands must begin in the menu in which the previous command ended. If this first command does not begin in the correct menu, an error message is printed and the file is not executed.

It is best, but not essential, to start and stop command files in the SELECT menu to minimize the likelihood of either beginning command-file execution in the wrong menu or appending commands that start in a menu different from that in which the existing command file ends. Frequent errors are likely if the user does not adopt the practice of always starting and stopping a command file in the same menu (the SELECT menu is recommended).

For example, suppose a user logs a series of commands, deactivates logging while in the STATUS menu, moves to the SELECT menu, reactivates logging, and logs more commands. In order for this series of commands to be executed, it would be necessary for REMOTE to know how to get from the STATUS menu to the SELECT menu on its own. It would be difficult to store the commands necessary to go from any arbitrary menu on the Hiden to any other arbitrary menu. REMOTE is not programmed to do this and lets the user know by displaying an error message and not executing any portion of the command file. Hence, if command logging is deactivated and then reactivated in a single file, the menu in which reactivation occurred must be the same as that in which deactivation occurred. If this is not done, the file must be edited to make the menus the same.

The filament status lines specify whether or not a filament should be on. Since the status of the filaments is extremely important in any command file, REMOTE checks to make certain that the filament status listed in the command file matches the Hiden's filament status before the command file is executed. If there is not a match, an error message is printed.

The multiplier status lines state whether the Hiden should be in Faraday or electron multiplier mode. This is also very important, so REMOTE checks that the multiplier status listed in the command file matches that of the Hiden. If there is not a match, an error message is printed.

Execution of a command file may be paused between commands by pressing any key. When execution is paused, the user may abort execution by pressing <ESC>, enter TTY mode by pressing ALT-T, toggle data logging by pressing ALT-L, and restart execution by pressing any other key. The data file name cannot be changed from within a command file.

As vacuum chamber cleanliness or vacuum chamber operations change, command files will usually have to be altered. Sometimes only a temporary alteration is needed. For example, an existing command file may specify the taking of scans that, for the time being, are not needed. If so, the user can bypass these scans by turning off the printer at the start of the scan, pressing F7 to abort the scan, and then pressing <ESC> to instruct REMOTE to continue with the execution of the command file. (If the printer is not turned off, the aborted scan will be printed if the SCAN command is followed by a PRINT command.)

A command file can be easily expanded by appending new commands. Also, by activating command logging and then executing another command file, a user can make a copy of the command file. Before and after execution, the user may log more commands to the new command file. This is useful if a user wishes to have a command file that performs all the commands of the previous file and also performs additional commands. For example, if a user has a command file stored on the hard disk named FILAMENT.CMD, which turns on filament 1, and wishes to create a command file named BARSCAN.CMD, which turns on filament 1 and then takes a scan in BAR mode, he or she can do the following:

Activate command logging
Execute command file FILAMENT.CMD
Perform whatever actions are necessary to take the BAR scan
Deactivate command logging

It is important to make each command file as complete as possible. For example, in a command file that takes a scan with a specific center mass and scan range in PROF mode, be sure to include the commands to set the center mass and the scan range in the file. This way, no matter which masses and ranges are in use when the command file is executed, the settings will be changed to the correct values.

IV. PRINTING AND EXITING TO DOS

A. PRINTING

Printing should be complete before a new data scan begins or before the Hiden's menu is changed. Otherwise, part of the scan data may be erased and not printed. At present, there is no way of knowing when the Hiden is or is not printing, or when printing is complete. Consequently, there is a brief delay (currently 20 seconds) after every PRINT command is issued. Twenty seconds is approximately the longest time that a print will require. Since most prints will only take about 10 seconds, there will be some wasted time; however, this is more than balanced out by the certainty of maintaining print integrity. (If a 20-second print time appears to be too short, as might be the case when an error message is displayed on the Hiden monitor before printing begins, the user can press any key once during printing to pause the execution of the command file. After printing is complete, the execution of the command file is resumed by again pressing any key. As this example shows, REMOTE is written so that the user can take action whenever a problem appears in the execution of a command file.)

B. THE DOS EXIT KEY

This key is used to exit from REMOTE to DOS. When the key is pressed, the user is asked if he or she wants to leave REMOTE. If the response is yes, REMOTE is exited.

V. TECHNICAL DATA

REMOTE was developed using Turbo Pascal V5.5 from Borland Corporation. The asynchronous communications and window routines are based on source code provided by Borland.

REMOTE V2.6 is designed for use with release 3.11R of the Hiden PROMs and has been tested on both a HAL 301 with a single quadrupole filter and a HAL 321 with a triple filter. Both of these instruments are analog RGA's, fitted with both a Faraday cup and an electron multiplier; they are not fitted with a SIMS probe. Testing has also been performed operating REMOTE over telephone lines using *pc*ANYWHERE III release 3.11a from Dynamic Microprocessor Associates, Inc. No special hardware is needed to run REMOTE, although a hard drive is recommended.

REMOTE requires an IBM-PC compatible computer with at least one serial communications port (for communications with the Hiden). To operate over telephone lines with *pc*ANYWHERE III, a second serial port is required (for communications via modem over the phone lines). REMOTE may be operated over phone lines at any baud rate, but a rate of at least 2400 baud is recommended.

ASCII character strings are used both to send commands to the Hiden and to receive status and error messages from the Hiden. According to its operating manual, the Hiden is capable of communicating at 19200 baud; however, 9600 baud is recommended, and this is the rate at which REMOTE communicates with the Hiden.

For further information about REMOTE, contact Dr. Karl Westberg at The Aerospace Corporation (310) 336-5889.

TECHNOLOGY OPERATIONS

The Aerospace Corporation functions as an "architect-engineer" for national security programs, specializing in advanced military space systems. The Corporation's Technology Operations supports the effective and timely development and operation of national security systems through scientific research and the application of advanced technology. Vital to the success of the Corporation is the technical staff's wide-ranging expertise and its ability to stay abreast of new technological developments and program support issues associated with rapidly evolving space systems. Contributing capabilities are provided by these individual Technology Centers:

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THE AEROSPACE CORPORATION
2350 E. El Segundo Boulevard
El Segundo, California 90245-4691
U.S.A.